# Deep inspiration breath hold in breast radiotherapy: Are significant reductions in cardiac doses observed?

R Mamon[1], H Chesham[1], G Bee[1], H Ariyaratne[1, 2], B Lavery[3], T Davies[4], S Jansen van Rensburg[1]

[1]Cancer Partners UK, United Kingdom [2]Mount Vernon Cancer Centre, Northwood, United Kingdom
[3]Oxford University Hospital, Oxford, United Kingdom [4]Northampton General Hospital, Northampton, United Kingdom
Email: research@cancerpartnersuk.org

## Purpose/objective

Radiotherapy treatment for breast cancer increases the risk of major coronary events[1], with dose received by the Left Anterior Descending (LAD) coronary artery an area of particular concern[2,3]. Published findings suggest an increase of stenosis in the mid and distal LAD coronary artery in breast patients where dosimetric hot-spots are observed within the structure[3].

This study explores the use of deep inspiration breath-hold (DIBH) as an effective method to reduce doses to the whole heart and LAD coronary artery during left sided breast irradiation.

## Material & methods

- This retrospective study investigates 296 left-sided breast cancer patients treated with DIBH across eight Cancer Partners UK centres between January 2014 and December 2014.
- All patients underwent two CT scans, one in free breathing (FB) and one in DIBH using the Spiro Dynr' X (SDX) breathing control system.
- Planning was completed on the DIBH scan using Phillips Pinnacle3 TPS and transferred to FB scans using tissue volume equivalence.
- An agreed internal standard atlas for whole heart and LAD contouring was followed to ensure consistency. A PRV margin of 1.0cm was added to the LAD.
- Mean dose to the whole heart was recorded for 296 patients along with 75 patients near maximum$_{(2\%)}$ and mean LAD coronary artery doses, as per ICRU 83.
- Treatment techniques included a two field tangential approach or a three field mono-isocentric technique irradiating additional nodal involvement.
- Dose regimes prescribed were either 40Gy/15# or 50Gy/25#.
- Patients were treated on Elekta Synergy or Versa HD linear accelerators using forward planned intensity modulated radiotherapy (IMRT).
- Statistical significance was validated using the Wilcoxon Signed Rank test.

Figure 1. DIBH Scan, Heart and LAD coronary artery contours are positioned away from tangential fields. Delineated organs at risk: *Purple line* LAD coronary artery, *Blue line* 1.0cm PRV margin around LAD coronary artery

Figure 2. FB Scan, Heart and LAD coronary artery in close proximity to tangential fields

## Results

A statistically significant reduction in whole heart mean dose and LAD coronary artery near maximum$_{(2\%)}$ and mean dose was demonstrated when using DIBH, see Table 1.

DIBH reduced whole heart mean dose in 99% (294/296), LAD coronary artery near maximum$_{(2\%)}$ in 97% (73/75) and LAD coronary artery near max dose in 100% (75/75) of the patient population.

Table 1. Comparison of cardiac doses - DIBH vs. FB

| Parameter | DIBH median (IQR) | FB median (IQR) | Median of differences (95% CI)* | Wilcoxon signed-rank test significance |
|---|---|---|---|---|
| Whole heart mean Dose/Gy | 0.96 (0.76-1.16) | 1.55 (1.10-2.00) | 0.62 (0.56-0.69) | p <0.001 |
| LAD mean dose/Gy | 3.83 (2.28 - 5.38) | 11.44 (6.99 - 15.89) | 7.28 (5.98-8.66) | p <0.001 |
| LAD near Max/Gy | 19.66 (8.26 – 31.06) | 38.81 (37.36 - 40.26) | 15.11 (12.32-17.70) | p <0.001 |

* Hodges-Lehmann estimate

## Results

Figures 3 - 5 summarise the results for whole heart mean, LAD coronary artery near maximum$_{(2\%)}$ and mean doses.

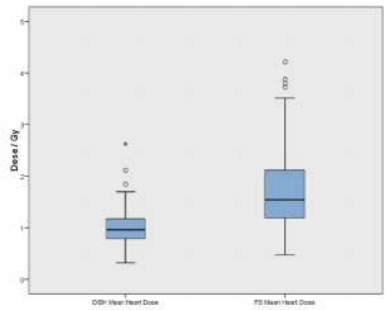


Figure 3. Comparison of whole heart mean dose - DIBH vs. FB

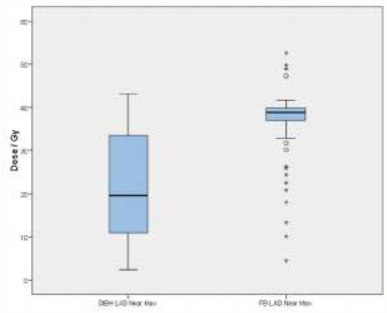


Figure 4. Comparison of LAD coronary artery near maximum$_{(2\%)}$ dose - DIBH vs. FB

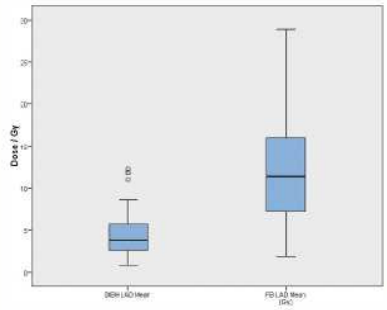


Figure 5. Comparison of LAD coronary artery mean dose - DIBH vs. FB

## Conclusions

DIBH significantly reduces cardiac doses during left breast radiotherapy treatment. This study demonstrated a statistically significant reduction in whole heart mean, LAD coronary artery near maximum$_{(2\%)}$ and mean doses. This technique has clear potential to decrease long-term cardiac complications in women having breast radiotherapy.

Additional work looking at long-term follow-up for individual patients in this cohort is required to highlight the clinical benefits of this technique. Furthermore, exploring predictive factors will help establish the required base-line for the patients that would benefit from this technique.

### References

1. Darby S.C., Ewertz M., McGale P, Bennet A.M., Blom-Goldman U, Brønnum D, Correa C, Cutter D, Gagliardi G, Gigante B, Jensen M-B, Nisbet A, Peto R, Rahimi K, Taylor C, Hall P, Risk of Ischemic Heart Disease in women after radiotherapy Breast Cancer, N Engl J Med, Vol 368, No. 11, pp 987–998.

2. Nissen H.D., & Appelt A.L., (2013), Improved heart, lung and target dose with deep inspiration breath hold in a large clinical series of breast cancer patients, Radiotherapy and Oncology, Vol 30, pp 380–386.

3. Lee M.S., Finch W, Mahmud E, (2013), Cardiovascular Complications of Radiotherapy, AM J Cardiology, Vol 112, pp 1688–1696.

Acknowledgements: Cancer Partners UK Physics and Dosimetry Department.

CANCER PARTNERS UK

Follow us

Cancer Partners UK Limited
Registered office: Wilson House, Waterberry Drive, Waterlooville, Hampshire PO7 7XX.
Registered number 05796994.
Registered in England and Wales.

www.cancerpartnersuk.org

1491--EP
Physics track: Intrafraction motion management
Ravinder Mamon
DOI: 10.3252/pso.eu.estro2015.2015
Poster presented at: 3rd ESTRO FORUM
PosterSessionOnline.com